REMARKS

In response to the Office action identified above, please accept the following remarks.

Examiner:

1. Claims 1-8, 11-18, and 21 are rejected under 35 U.S.C. 102(b) as being anticipated by Werkhoven et al. (US 2001/0041250 A1).

The Werkhoven et al. patent (Werkhoven) discloses a method of forming at least one dual damascene wire on a substrate (figs. 9, 10, and accompanying text). The method comprises the steps of: forming a barrier layer 432 on a surface of an insulating layer 402, 404, 408, 410 and on an exposed conductive region 406 - the insulating layer including a trench pattern and a via hole pattern formed therein (figs. 9, 10, and par. 101, lines 1-3); forming a continuous and uniform conductive layer 434 on a surface of the barrier layer (figs. 9, 10, and par. 101, lines 1-3); forming a seed layer 436 on a surface of the conductive layer (figs. 9, 10, and par. 101, lines 1-3); and forming a metal layer 426 on a surface of the seed layer, wherein the metal layer fills the trench pattern and the via hole pattern (fig. 9; par. 99, lines 1-3; par. 101, lines 8-10; and par. 135, lines 1-4).

The substrate comprises a semiconductor wafer (par. 42, lines 1-7).

The conductive region 406 comprises a lower level wire or landing pad (fig. 9 and par. 96, lines 3-5 and 10-12).

The barrier layer 432 comprises a titanium nitride layer (TiN), tungsten nitride (WN), tantalum nitride layer (TaN), or other conductive nitride layers (par. 101, lines 3-5).

The conductive layer 434 comprises a tungsten (W) layer (par. 102, lines 3-6; par. 103, lines 10-21; and par. 123, line 1 - par. 125, line 7).

The conductive layer 434 is formed using an atomic layer deposition (ALD) process, and has a thickness in a range from 5 to 400 angstroms (Å) (par. 103, lines 14-21; par. 123, line 1 - par. 125, line 7; and par. 131, lines 3-8).

The seed layer 436 is a copper layer, which has a thickness in a range from 5 to 2000 angstroms (Å) (par. 103, lines 23-28 and par. 134, lines 1-6).

An electric copper plating (ECP) process is used to form the metal layer 426 (par. 135, lines 1-4).

Response:

First, claim 6 is merged into claim 1 and claim 17 is merged into claim 13 to overcome this rejection. Claims 6 and 17 are therefore canceled.

Second, the Applicant intends to point out the difference between the amended claim 1 of the present application and Werkhoven's method of forming at least one dual damascene wire on a substrate. The amended claim 1 of the present application is repeated below for convenience:

Claim 1 (Currently amended): A method of forming at least one wire on a substrate, the substrate comprising at least one conductive region, an insulating layer disposed on the substrate, and the insulating layer comprising at least one recess exposing the conductive region, the method comprising:

forming a barrier layer on a surface of the insulating layer and the recess;

forming a continuous and uniform conductive layer on a surface of the barrier layer, **the conductive layer comprising an aluminum layer or a tungsten layer**;

forming a seed layer on a surface of the conductive layer **and interlaying the conductive layer between the seed layer and the barrier layer**; and

forming a metal layer on a surface of the seed layer, and the metal layer filling up the recess.

As disclosed in the amended claim 1, the conductive layer interposed between the seed layer and the barrier layer is composed of an aluminum layer or a tungsten layer. Because the conductive layer has superior continuity, uniformity and current conductive ability, the overall conductivity uniformity is effectively improved to distribute the current evenly during the subsequent manufacturing process of the metal layer.

In Werhoven's disclosure, however, the conductive layer 434 interposed between the seed layer 436 and the barrier layer 432 does not comprise an aluminum layer or a tungsten layer (Fig. 10). Werkhoven specifically teaches that the conductive layer 434 is a transition region between the barrier layer 432 (which comprises tungsten nitride WN_x) and the seed layer 436 (which comprises copper Cu), and the transition region 434 comprises a conductive nitride (paragraph 0101) or a graded layer of tungsten copper nitride [$(WN_x)_yCu_z$] (paragraph 0102).

Since Werkhoven never teaches that the conductive layer 434 interposed between the seed layer 436 and the barrier layer 432 is either an aluminum layer or a tungsten layer, the Applicant believes that the conductive layer (transition region) 434 taught by Werkhoven cannot be read as the conductive layer disclosed in the amended claim 1.

From the above discussion, the Applicant respectfully believes that the amended claim 1 of the present application is absolutely different from Werkhoven's disclosure. Reconsideration of the rejection over claim 1 is hereby requested.

Claim 13 is amended to include similar features as in the amended claim 1 and is believed different from Werkhoven's disclosure. Reconsideration of the rejection over claim 13 is requested.

As claims 2-5, 7-8, 11-12, 14-16, 18, and 21 are

dependent upon the amended claims 1 and 13, respectively, they should be allowed if the amended claims 1 and 13 are allowed. Reconsideration of claims 2-5, 7-8, 11-12, 14-16, 18, and 21 is therefore requested.

Claims 6 and 17 are canceled and therefore no longer in need of consideration.

Examiner:

2. Claims 9, 10, 19, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Werkhoven in view of Tarumi et al. (US 2004/0018722 A1).

Werkhoven lacks anticipation only in not teaching that: the seed layer is a copper alloy, and is formed using a physical vapor deposition (PVD) process.

The Tarumi et al. Patent (Tarumi) discloses a method of forming at least one dual damascene wire on a substrate (figs. 1A-6B and accompanying text). The method comprises a step of forming a seed layer 21, wherein the seed layer is either a copper layer or a copper alloy layer (fig. 4B and par. 48, lines 1-8). The seed layer is formed using a sputtering process, which is a PVD process (par. 48, lines 1-8).

Since Werkhoven and Tarumi are from the same field of endeavor, the purpose disclosed in Tarumi would have been recognized in the pertinent reference of Werkhoven by one of ordinary skill in the art at the time the invention was made.

It would have been obvious to one having ordinary skill in the art, at the time the invention was made, to modify Werkhoven in view of Tarumi, by forming the seed layer of a copper alloy and using a PVD process to form the seed layer, as taught by Tarumi, for the following reasons: as in the case of copper, a copper alloy with a relatively high percent composition of copper enables direct nucleation of electroplated copper; and sputtering is an alternate deposition process commonly used to form copper-containing seed layers in dual damascene structures.

Response:

As claims 9, 10, 19, and 20 are dependent upon the amended claims 1 and 13, respectively, they should be allowed if the amended claims 1 and 13 are allowed. Reconsideration of claims 9, 10, 19, and 20 is therefore requested.

Sincerely yours,

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